ADVENTIVE PLANTS AT TEMPLE BASIN SKI-FIELD, ARTHURS PASS NATIONAL PARK

David Norton and Colin Burrows

Department of Botany,
University of Canterbury, Christchurch, New Zealand

ABSTRACT

The distribution of adventive plants at Temple Basin is described in relation to various kinds of disturbance in the ski-field area. Study plots and photo points were established so that there will be a permanent record of the incidence of adventive plants and change in their populations may be monitored. The plants with the greatest potential for further spread are identified and recommendations made for the removal of as many of the adventive species as seems feasible.

INTRODUCTION

The spread of adventive plants (i.e. plants foreign to the native flora, which establish and maintain themselves) in New Zealand has been recorded by several authors (e.g. Thomson 1922, Healy 1968, Dobson 1977). The only full published list of adventive plants in high mountain areas in the South Island are those of Wardle (1975) and Wilson (1976) in Westland and Mount Cook National Parks, respectively.

It is noteable that, in general, high mountain vegetation in New Zealand resists invasion by foreign plants, presumably because the native plants are well adjusted to their environment and, on climatically favourable sites with fine soils, there is usually a dense closed plant cover. On less favourable, open sites with coarse, stony soils the scattered native plants often already occupy available microhabitats. However, if there is habitat disturbance, by natural agencies or by man, certain introduced plants can take advantage of the lack of competition and invade. Invasion occurs when seeds (or other disseminules) are transported from sites already occupied by the adventive plants, via various kinds of human intervention or by animals, wind or water.

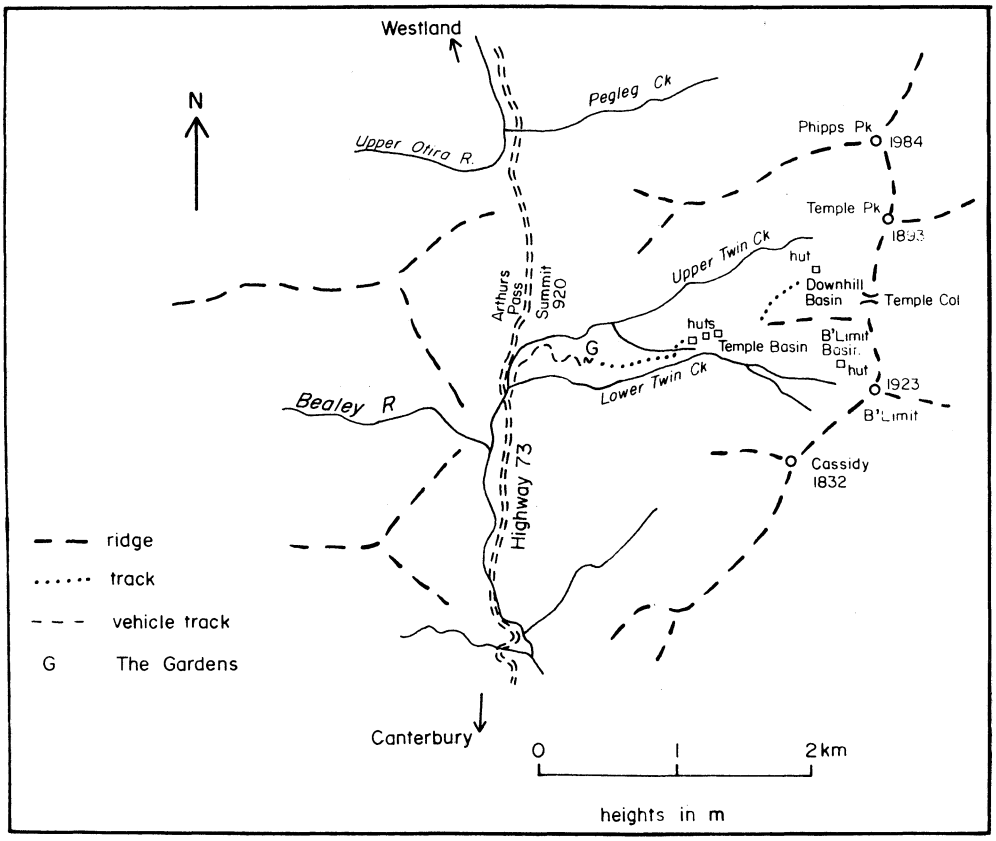

Fig. 1. Arthurs Pass summit area and Temple Basin

This paper records the present adventive flora of Temple Basin, a ski-field north of Arthurs Pass, on the Main Divide of the Southern Alps, in Arthurs Pass National Park (Figs. 1, 2). Permanent study plots and photo points for monitoring change in the adventive flora are described.

STUDY AREA

ACCESS

From the transalpine Highway 73 (at 915m), access to Temple Basin is by a track, negotiable to The Gardens (1065m) by four-wheel drive vehicles and there on by foot track. The main living area at Temple Basin is at 1372 m, and the main ski-field (and

adjacent learners' fields) extends to 1525 m. A higher field with shelter hut and ski-tow, Downhill Basin, extends from 1525 m to 1700 m and it is accessible from the main ski-field by a foot track. B'Limit Basin, further east, is seldom used for skiing, but has a small shelter hut. (Fig.2)

Other access to Temple Basin, strictly for materials, is by helicopter and by a goods cable-lift from Highway 73.

HISTORY

Skiing commenced at Temple Basin in 1929. The Christchurch Ski Club built the first hut there in 1933. In 1954 the hut was sold to the Canterbury University Ski Club and C.S.C. built a new hut (42 beds). The C.U.S.C. built a new hut in 1965 and enlarged this in 1978 (30 beds). A day shelter, built about 1950, was removed in 1972 when the Arthurs Pass National Park Board built a larger shelter. The old C.U.S.C. hut was removed in 1978. The day hut in the Downhill Basin was built in 1970, the small hut in B'Limit Basin in the 1950's and the goods lift in 1960 (Burrows 1978).

STATUS

According to the National Parks Planning Classification scheme, (National Parks Authority, 1975), Temple Basin is a "Facilities Area", within which the Arthurs Pass National Park Board has permitted controlled development of the skiing facilities. The ski-field and ancillary facilities (except the access track and goods lift) occupy about 3.5 ha.

Under the National Parks Act, 1952, all foreign plants (i.e. adventives) in the Park are regarded as weeds and attempts are made to eradicate the aggressive, promient species. Many adventives however, are very well established in lower altitude parts of the Park and there is little hope of their removal. As far as we know there has been no serious attempt to control adventives at Temple Basin.

CLIMATE

Temple Basin has an annual average precipitation (water equivalent) of about 500 cm, about 25% - 30% as snow during winter. It is exposed to the west and experiences strong winds, usually with heavy rainstorms. Frosts may occur in any month of the year, but the heaviest winter frosts (to about -12°C) infrequently affect ground which is protected by a snow cover. Temperature at ground level is maintained at about 0° and streams continue to flow beneath the snow. Summer air temperatures rise to about 28°C maximum (Burrows 1968).

NATIVE VEGETATION

Only a very brief description is given here. For a more detailed description of native plant communities see Burrows (1968). The modal vegetation on gley soils at Temple Basin is knee-high (or shorter) *Chionochloa pallens - C. crassiuscula* grassland, often with many herbs and dwarf shrubs. On the more fertile soils this vegetation grades into taller, dense *C. pallens* grassland, with herbs. On rocky and/or sunny slopes and near The Gardens waist-high or taller scrub is present, containing *Dracophyllum uniflorum, Podocarpus nivalis* and *Chionochloa flavescens*, with several other shrubs and many herbs. Lower on the access track similar vegetation contains *D. longifolium* and on wet sites, *C. rubra*. Small flushes (with *Schoenus pauciflorus*) or cushion bogs (with *Donatia novae-zelandiae*) occupy hollows in Temple Basin.

METHODS

During the summer 1978-79 several visits were made to Temple Basin (by D.N.). Prior observations had been made at Temple Basin (by C.J.B.) at irregular intervals since 1960. Within areas of irregular size and shape (Fig.2), chosen to represent units associated with different ski-field functions, lists of introduced plants were made. Notes were taken of relative abundance, relative vigour or aggressiveness and potential for spread of the plants and of their association with various kinds of disturbance. Eight permanent study plots and ten photo-points were established to monitor change in the plant populations (Figs. 2,3) (Appendix I).

The main areas for study (Fig. 2) were:

1. Public shelter and main entrance area to University Ski Club hut.
2. Upper portion of goods lift.
3. Access track near public shelter and Ski Club huts (an area which includes some undisturbed vegetation).
4. Main entrance area to Christchurch Ski Club hut.
5. Rear of Ski Club huts, containing oil fuel tanks.
6. Main track to ski-tow from huts, also containing disturbed ground around trenches for burial of water pipes and telephone lines (some undisturbed vegetation is present).
7. Main ski tow, with oil fuel tank and small hut, sites of two old huts (now removed), an old septic tank and a new, short ski-tow.

8. Learners ski-tow and hut with oil fuel tank.

9. Septic tank from ski huts.

10. Old sewer outfall.

Further general observations of occurrence of adventive plants were made on the Arthurs Pass summit area at the bottom of the access track, along the access track, at The Gardens, above the main ski-field on the track to the shelter hut at the Downhill Basin and around this hut and in B'Limit Basin.

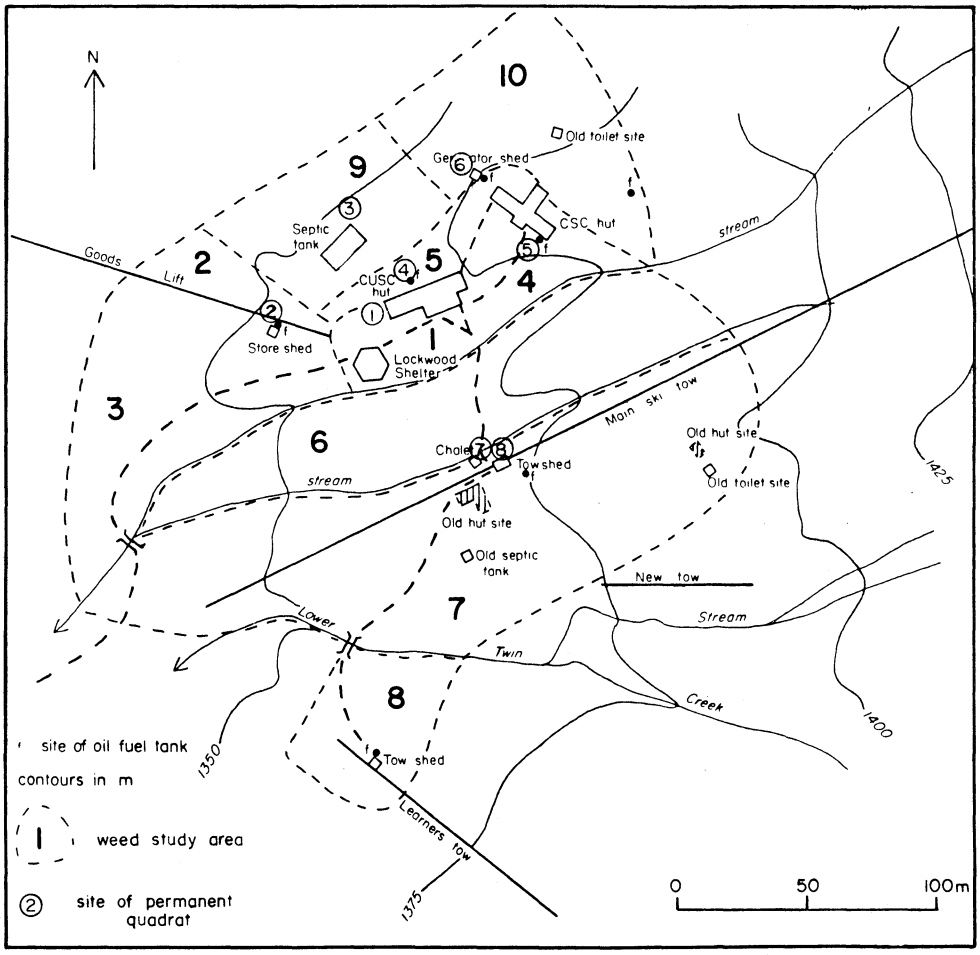

Fig. 2. The main ski-field at Temple Basin, showing the study areas for records of occurrence of weeds (cf. Table 1) and sites of permanent quadrats. Buildings not to scale.

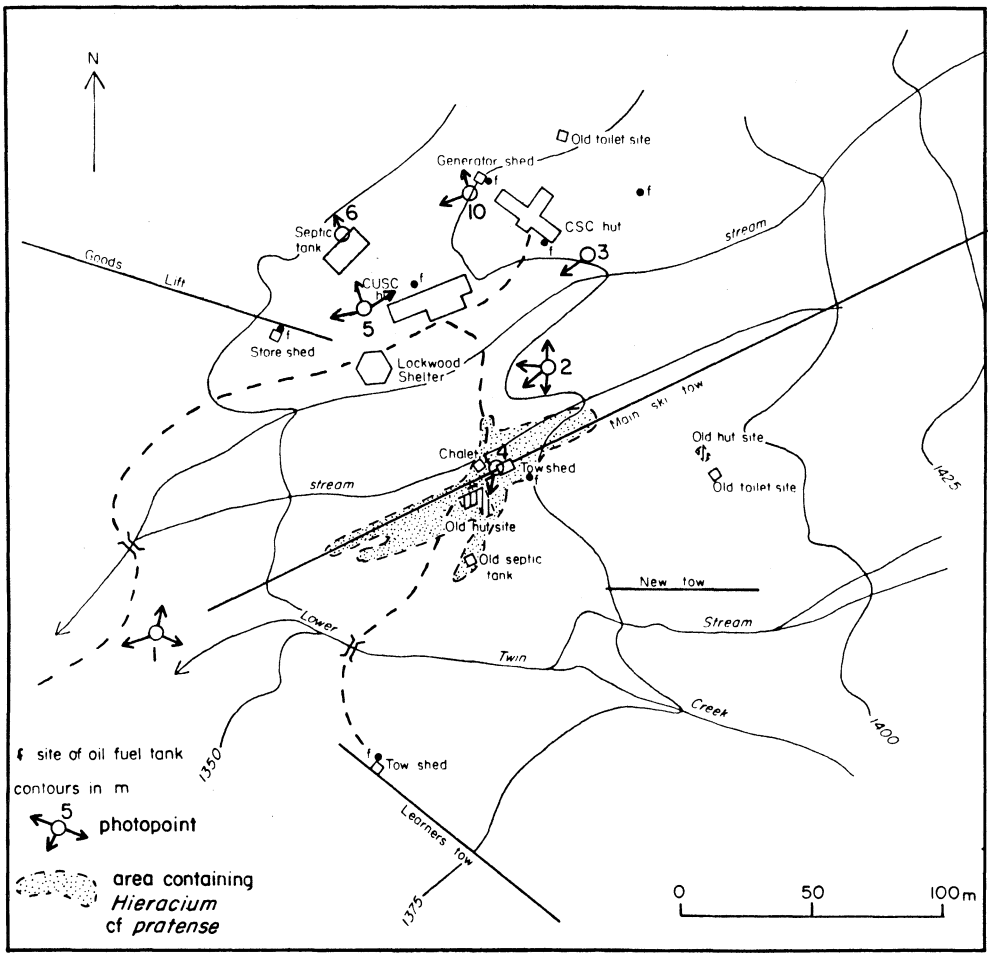

Fig. 3. Positions of permanent photopoints and the area infested by *Hieracium cf. pratense*. Buildings not to scale.

RESULTS

The following disturbances of soil and vegetation were noted near the huts and ski-tow facilities:

1. Heavy, continued trampling. Along most tracks the vegetation has been completely destroyed and heavy runoff during rainstorms, or during the snow thaw has eroded the soil. Track margins show signs of severe trampling pressure. Bare soil is affected by needle ice during frosty weather when there is no snow cover. The loosened soil is easily eroded by wind and water and bare places are maintained in

this way. About the huts and goods lift, continued heavy trampling has killed or severely limited the native vegetation. There has also been heavy wear and often severe damage, killing of vegetation and baring of soil near ski-tows. Wet areas are particularly vulnerable.

2. Excavations. On the sites of all excavations for buildings, septic tanks, water pipes, telephone lines and oil fuel pipes native vegetation has been killed, leaving disturbed, bare soil. In the difficult mountain environment the native vegetation is slow to recover.

3. Deposition of Materials. Temporary storage of building materials has killed some vegetation near ski huts. Dumping and/or burning of old ski-tow rope has damaged at least one small area. During building operations there have been several occasions when sheets of metal or board have been blown over the ski-field area and left to lie. Often these have killed equivalent-sized areas of vegetation. Much rubbish (paper, plastic bags, soft-drink cans etc.) from winter operation of the ski-field is evident after the snow melt each spring. Individually only very small areas of vegetation are affected but collectively and cumulatively the effects are noticeable. They are most evident about the huts and, in their vicinity there is also enrichment by organic materials (food, urine) which influences the fertility status of the soil.

4. Oil Spills. Under most of the oil fuel tanks (some now removed) supplying huts, ski-tow and goods lift there have been oil spills which killed all vegetation in a narrow strip downhill (Fig. 4). This kind of disturbance is lethal to introduced as well as native plants, but, in future, when the immediate effects have died away (and provided there are no more spills) bare areas will be available for colonization by adventive plants.

5. Sewage Effluent. Under each of the effluent outfalls from old septic tanks in small gullies carrying streamlets. extreme enrichment of the soil or water has created a further kind of environmental disturbance (Fig. 4.) Sewage is now confied to one large septic tank.

Table 1 records the distribution of adventive plants at Temple Basin with an indication of which species pose the most serious threat to the native ecosystems, and which species are uncommon or localized in their occurrence and not of serious consequence. All other species are moderately to very common and well-established, but not likely to spread further unless there is more disturbance.

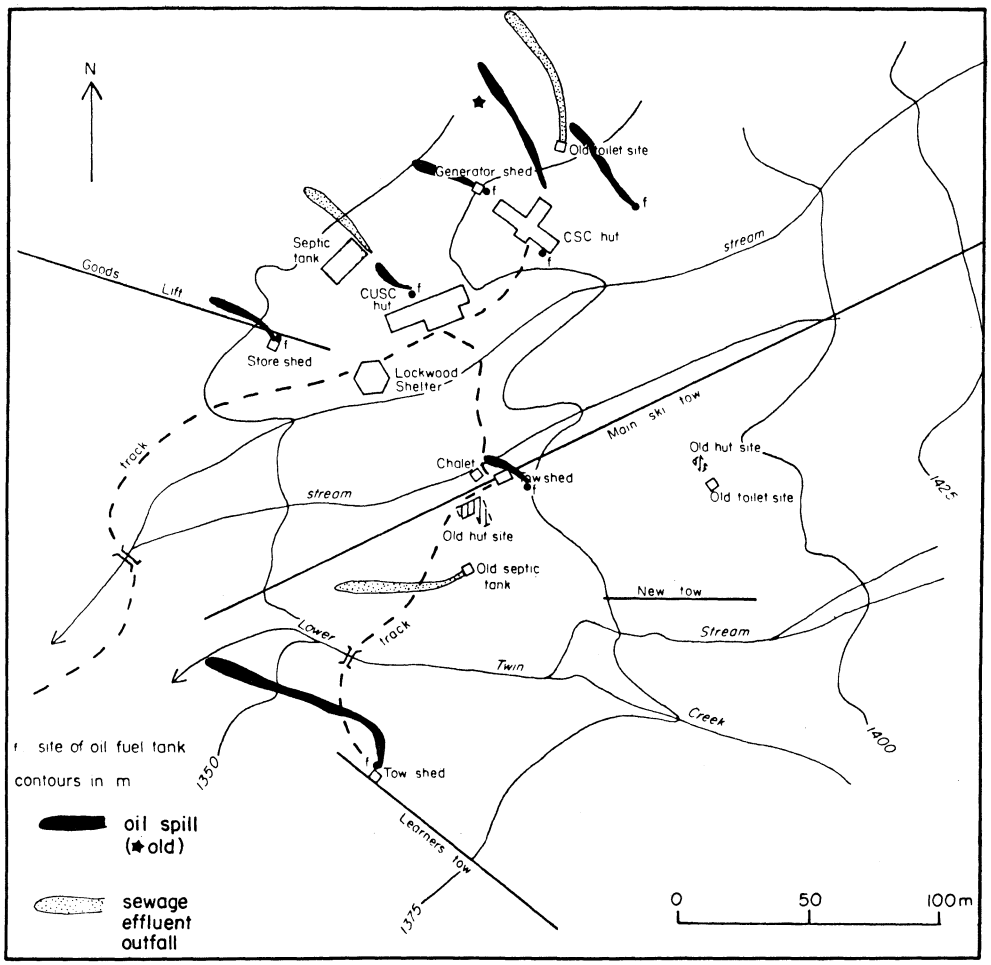

Fig. 4. Positions of oil spills and sewage effluent outfalls. Buildings not to scale.

It is clear that the adventive species *Cerastium holosteoides*, *Mycelis muralis*, *Taraxacum officinale*, *Hypochoeris radicata*, *Festuca rubra*, *Poa annua*, *Anthoxanthum odoratum* and *Agrostis tenuis* are not limited by the severity of the alpine habitat at altitudes up to 1525 m, provided that disturbed ground is present. All occur around the hut in the Downhill Basin. Of all the adventive species only *Poa annua* was observed flowering freely at Temple Basin and presumably it sets seed. Some other species (e.g. *Hieracium* cf. *pratense*) may do so but no visit was made late in summer to check this. Vegetative proliferation and spread is important in the aggressive Species (Table 1).

In Appendix I the detailed study plots and photo points are recorded. Field sheets for these, with full descriptions, and photo negatives are held by C.J.B.

TABLE 1. DISTRIBUTIONS OF ADVENTIVE PLANTS IN THE MAIN STUDY AREAS, TEMPLE BASIN.

	Study Areas													Status	
	1	2	3	4	5	6	7	8	9	10	A	G	P		
PAPILIONACEAE															
Trifolium repens	+	+									+	+		s	v
LINACEAE															
Linum catharticum	+										+			u	
RANUNCULACEAE															
Ranunculus repens				+							+			s	v
CRUCIFERAE															
Capsella bursa-pastoris									+					u	
CARYOPHYLLACEAE															
Cerastuim holosteoides	+	+	+	+	+	+	+		+	+	+		+	s	v
Stellaria alsine					+		+		+	+	+				v
S. media									+					s	v
PLANTAGINACEAE															
Plantago major		+		+		+	+				+			s	
POLYGONACEAE															
Rumex acetosella		+									+	+		s*	v
R. obtusifolius							+							u	r
COMPOSITAE															
Achillea millefolium				+							+	+		s	v
Cirsium arvense				+										s	v
C. vulgare				+					+		+			s	
Crepis capillaris	+	+		+	+		+		+	+	+			s*	
Hieracium pilosella					+						+			s	v
H.cf. *pratense*	+					+	+	+			+	+		s*	v
Hypochoeris radicata							+			+	+	+	+	s*	r
Mycelis muralis											+		+	s	
Taraxacum officinale					+		+		+	+	+		+	s*	r
GRAMINEAE															
Agrostis tenuis	+	+	+	+	+	+	+	+	+	+	+	+	+	s*	v
Anthoxanthum odoratum						+					+	+	+	s	
Dactylis glomerata							+							u	
Holcus lanatus												+		u	
Festuca rubra	+		+	+	+		+						+	s*	v
Lolium sp.				+										u	
Poa annua	+	+	+	+	+	+	+	+	+	+	+	+	+	s	
P. pratensis	+			+			+	+	+	+				s*	v

Study areas as in Fig. 2, A = access track to Temple Basin, G = "The Gardens", P = Arthur's Pass summit at foot of access track.

s = Aggressive species, likely to maintain themselves permanently or spread further, particularly if disturbance continues. Those marked * may eventually invade natural, open habitats.

u = Uncommon species, probably not likely to spread much further. New introductions may occur however.

v = Species with active vegetative proliferation by stolons or rhizomes.

r = Species with vegetative proliferation if rootstock is broken.

DISCUSSION

In the absence of specific observations, discussion of the dispersal of adventive plants seeds to Temple Basin must be speculative. The most likely means of transport of many seeds is on human clothing or equipment, probably accounting for the majority of species. Also it is likely that some adventive seeds arrived in packing or on materials brought for ski-field operations.

Although no control areas are described, extensive observations by C.J.B. during 1960-70 in the undisturbed alpine vegetation at Temple Basin (including several dozen vegetation sample plots, sites at random) show that the adventive plants are almost entirely confined to distrubed areas. Infestations of these plants are particularly evident where disturbance is in the form of frequent trampling, upheaval of the soil by excavation and/or near huts where there is enrichment by organic materials, such as food in hut sweepings, or urine and near the outfalls for sewage effluent. Along most of the access track adventive plants are uncommon and scattered.

Cerastium holosteoides is the only adventive which seems capable of living in certain closed native alpine grasslands. It is never prominent in these. It and *Rumex acetosella* may also invade naturally distrubed areas like scree margins, as they do in more easterly mountain ranges, but there is little sign of this at Temple Basin. The most serious weeds, which probably have the potential to spread beyond the present nucleus areas, are *Hieracium* cf. *pratense*, *Agrostis tenuis*, *Crepis capillaris* and possibly *Hypochoaeris radicata*, *Taraxacum officinale*, *Festuca rubra* and *Poa pratensis*. *Hieracium* cf. *pratense* has also been observed (by C.J.B.) invading short native vegetation on moraines in the upper Clyde River, Rangitata catchment. There it probably originated in packing from a hunter's air drop, since the site is on an old deer-hunters' camp and about 25 km from the nearest settlement. *Poa annua*, though very common at Temple Basin, does not appear capable of spreading away from disturbed areas near the huts. The same applies to *Stellaria media* and *Plantago major*.

Probably all other adventive plants will persist as a permanent component of the vegetation, but confined to disturbed areas. Some may disappear, especially if the native vegetation is allowed to recover. This probably applies to *Stellaria alsine* on the old sewage outfalls and to the less common species like *Linum catharticum*, *Capsella bursa-pastoris*, *Rumex obtusifolius*, *Cirsium arvense*, *C. vulgare*, *Dactylis glomerata*, *Holcus lanatus* and *Lolium* sp.

The main causes of localized distribution of adventive plants in Temple Basin seem to be threefold: (1) Disturbance of the ground, which not only provides competition-free habitat, but probably also slightly improves the nutrient status of the topmost soil layers. (2) Enrichment of the areas around buildings by various organic inputs from the activities of ski-field users. (3) Influx of seed, probably mainly on clothing, or materials brought by goods lift or helicopter. No

examination of accidental seed transport in these ways was made. Careful study of seed influx is required and of flowering, seed set and seed distribution by adventives established in Temple Basin. Careful observations of flowering and seed set of established plants are needed.

Great care should be taken to avoid transport of seed in packing materials. Transport of seed on clothing (e.g. on muddy boots), would be very difficult to control. Care is also need to prevent further distrubance or keep it to a minimum. Oil spills are preventable and there should be little need for the digging of more trenches.

We recommend that efforts should be made to destroy *Trifolium repens, Ranunculus repens, Stellaria media, Plantago major, Rumex obtusifolius, Achillea millefolium, Cirsium arvense, C. vulgare, Crepis capillaris, Hieracium pilosella, H.* cf.*pratense, Hypochoeris radicata, Taraxacum officinale, Agrostis tenuis* and *Poa pratensis* in case they spread more extensively at Temple Basin. Physical methods should be employed rather than herbicides, but this will be very difficult with rhizomatous, stoloniferous or deep-rooting species with brittle rootstocks (Table 1). The problem of their control is intensified by the need to prevent further soil distrubance. Painting-on of herbicide will be an effective and reasonably safe technique with some species. We see as a prime task control of the pernicious weed, *Hieracium* cf. *pratense*.

LITERATURE CITED

BURROWS, C.J. 1968. The ecology of some alpine grasslands. Unpublished Ph.D thesis, University of Canterbury, New Zealand. 218pp.

BURROWS, C.J. (Ed.) 1978. *Handbook to the Arthur's Pass National Park.* (3rd Edition). Arthur's Pass National Park Board. 104 pp.

DOBSON, A.T. 1977. Adventive plants. pp.271-278. *In:* Burrows, C.J. (Ed). *Cass: History and Science in the Cass district, Canterbury.* Department of Botany, University of Canterbury, New Zealand. 418 pp.

HEALY, A.J. 1969. The adventive flora of Canterbury. pp. 261-333. In: Knox, G.A. (Ed.) The natural history of Canterbury. Reed, Wellington. 620 pp.

THOMSON, G.M. 1922. *The naturalization of animals and plants in New Zealand.* Cambridge University Press, Cambridge. 607 pp.

WARDLE, P. 1975. Vascular plants of Westland National Park (New Zealand) and neighbouring lowland and coastal areas. *New Zealand Journal of Botany 13:* 497-546.

WILSON, H.D. 1976. Vegetation of Mount Cook National Park, New Zealand. *National Park Authority Scientific Series No.1.* 138 pp.

APPENDIX I: PHOTOPOINTS AND PERMANENT QUADRATS AT TEMPLE BASIN (Figs, 2,3)

N.B. All bearings are magnetic, as in December 1978.

PHOTOPOINTS

1. Centre is a bolt on rock outcrop, 13.1 m from N. post of main goods lift, (Bearing 252°).
   Photo (a) Bearing 355° - towards track to Lockwood shelter.
   (b) Bearing 100° - towards Cassidy oil spill.
   (c) Bearing 250° - towards access track.

2. Centre is a bolt at W. end of Learners Knob.
   Photo (a) Towards CSC hut.
   (b) Towards CUSC hut - Lockwood shelter.
   (c) Towards access track.
   (d) Towards Ski tow and shed.

3. Centre is a point 5.5 m N.W. of water intake point for Lockwood shelter.
   Photo (a) View down small stream which flows on east side of Lockwood shelter.

4. Centre is N.W. corner of main ski tow shed.
   Photo (a) Towards former site of old CUSC hut.

5. Centre is a bolt on rock 8 m from N.W. corner of CUSC hut (bearing 270°).
   Photo (a) Bearing 60° - rear of CUSC hut.
   (b) Bearing 340° - towards new septic tanks.
   (c) Bearing 220° - towards goods lift.

6. Centre is a bolt in rock above sewage outfall from CUSC hut.
   Photo (a) View down sewage outfall.

7. Centre is at bend of access track at break of slope where track leaves zig-zag and continues toward ski huts.
   Photo (a) View down track.

8. Centre as above, but just below sign "Please keep to track".
   Photo (a) View up track.

9. Centre as above, but at top of fenced off short-cut track.
   Photo (a) View down short-cut.

10. Centre is a bolt on rock about 5 m W. of CSC generator shed.
    Photo (a) View toward oil spill below generator shed.
    (b) View down hill.

PERMANENT STUDY PLOTS

All plots are 1 m^2 quadrats, not marked permanently on the ground. All but Nos. 7 & 8 were photographed.

1. Area affected by storage of building material, trampling. N.W. corner is 10 m from bolt which is centre of photopoint 5, N.E. corner is 9.15 m from N.W. corner of CUSC hut and S.E. corner is 8 m from S.W. corner of CUSC hut.

Cover: Moss 30%, *Agrostis tenuis* 10%, other plants < 10%, bare c. 60%.
Present: *Cerastium holosteoides*, wire, nails, coke, signs of fire.

2. Area on old oil spill.
S.W. corner is 8 m from northernmost corner of goodslift store shed on a bearing of 282° which continues the southern side of the plot.
Cover: bare, stone 95%.
Present: *Poa annua*.

3. Area on old sewage outfall.
S.W. corner is 3 m from bolt on large boulder and 10.3 m from bolt on rock outcrop near and below N.E. end of new septic tank.
Cover: *Stellaria alsine* 90%, *Poa annua* 10%.
Present: *Poa pratensis*.

4. Area on old oil spill.
S.W. corner is 0.5 m from bolt in rock at rear of CUSC hut between old sewer pipe and water pipe.
Cover: Dead plants 50%, bare, stones, boulders 50%.
Present: *Poa annua*.

5. Trampled area E. of CSC hut.
S. corner 8 m from aerial post, W. corner 7.7 m from aerial post, E. corner 3 m from bolt in rock.
Cover: *Agrostis tenuis* 50%, *Poa colensoi* 10%, dead plants 50%, bare 20%.
Present: *Poa annua*.

6. On recent (1978) oil spill from fuel tank at CSC generator shed. Marked with an aluminium stake (see photo).
Cover: Dead plants 75%, bare 25%.

7. Heavily trampled area on E. side of A-frame chalet. S. corner 1 m from S.E. corner of chalet, N. corner 2.3 m from N.E. corner of chalet.
Cover: *Poa annua* 40%, bare 50%.
Present: *Agrostis tenuis*, *Plantago major*.

8. Trampled area on N. side of main tow shed. S.E. corner 1.7 m from N.E. corner of tow shed, S.W. corner 3.8 m from N.W. corner of tow shed. (parallel with stone embankment).
Cover: *Hieracium* cf *pratense* 20%, bare, stone 75%.
Present: *Poa annua*, *Agrostis tenuis*.